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GENETIC VARIATION IN ANDROPOGON

John F. Davidson and Paul F. Romberg

There appear to be three species of *Andropogon* in Nebraska, *Andropogon Gerardi* Vitman (*A. furcatus* Muhl.), *A. Hallii* Hack., and *A. scoparius* Michx.

As a prelude to a taxonomic investigation of the Nebraska andropogons by the junior author, collections were made during the summers of 1949 and 1950 from eighty-three of the ninety-three counties of the state.[1] In making these collections, material was taken only from areas which showed no signs of recent disturbance. This precaution was taken to avoid, as far as possible, the sampling of populations which might be of hybrid origin, and especially those with a short life-span. The tendency for hybrids and other such genetically mixed individuals to occur along roadsides, railway embankments, in cultivated fields, washouts, and other such disturbed areas, has been pointed out by Heiser (1949).

In the field, the variation between the individual plants was very evident. The plants varied in the following respects:

(1) height of plant—low to tall,
(2) culm shape—cylindrical or flattened,
(3) foliage color—green or glaucous,
(4) anthocyanin content of culm and leaves—marked or absent,
(5) pubescence of leaf and culm—copious or light,
(6) anther color—red, yellow, or purple,
(7) length of rhizome internode—short or long.

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When the collections were made, the rhizomes were carefully traced, some portions of the plant were pressed for preservation in the herbarium, and other portions of the same plant were tagged with the collection number and retained for garden and greenhouse culture. Thus the plants growing in the garden and greenhouse and the preserved herbarium specimen are members of the same clone, and are presumably genetically identical. In the greenhouse, the plants were grown under uniform conditions, and were allowed to become dormant in the fall. After a month of dormancy, they were exposed to artificial illumination comparable to a sixteen-hour day. Within four months, the plants in the greenhouse were in flower.

The clone members used for garden culture were planted as soon as possible, and the position of each specimen in the garden was plotted as a safeguard against possible loss of the metallic tag bearing the collection number. In the majority of cases, the individuals survived the transplanting and winter conditions, and resumed growth in the spring.

Comparison of the growing plants and respective herbarium specimens afforded a means of determining to what degree the variation observed in the field was controlled by the environment, and to what extent by the genetic constitution of the individual plants. If the members of the same species all reverted to a common morphology under the uniform culture conditions, it could be assumed that the variation found in the field was due entirely to the influence of the environment. If, however, some of the morphological variations observed in the field were retained when the variants were grown under uniform conditions, such variations could be assumed to be produced by differences in the genetic constitution of the plants. As has been pointed out by Clausen, Keck and Hiesey (1940), there is no reason to expect a cumulative effect after transplanting, since the alteration in the physiology of the plant is effected immediately, and changes in morphology show up with the new growth at once. Thus the results obtained from two years' culture may be considered valid.

Of the field variations mentioned above, none were found to be due entirely to the effects of the environment, and only one, the height of the plant, was found to be modified upon transplanting. Plant height, in *Andropogon Gerardi,* was found to vary in the field from eighteen to seventy-two inches, but these heights were not maintained after transplanting. This is probably to be expected because of the changed nutrition and the differential checking of the growth through transplanting. It was interesting to find that those plants which had been taller in the field were also taller in the experimental garden. It would appear that tall-

ness here is not controlled by nutrition alone nor yet by heredity alone. The other variations noted in the field appeared to be controlled by the genetics of the individuals, inasmuch as the experimental plants retained the same degrees of variation as exhibited in the herbarium specimens obtained from the natural populations.

The assumption has been made in the past by Bonnier (1895), Clements (1929), and more recently by Weaver and Darland (1949), that observation of variation in growth based upon the same species of plant in nature was a valid means of determining the effect of the environment upon the plants observed. Such an assumption is predicated upon the hypothesis that all members of the same species will react similarly, which implies that their genetic constitutions are identical.

The contributions of Kerner (1891), Turesson (1922), and Clausen, Keck and Hiesey (1940), indicate that genetic identity throughout a species cannot be assumed, but rather that species are commonly composed of varying numbers of genetic strains, some of which may be ecologically significant. The present findings in the genus *Andropogon* tend to confirm the latter viewpoint. The delineations of ecotypes by Turesson, by Clausen, Keck and Hiesey, and by Boecher (1949), were based upon studies of species occupying a wide range of quite diverse environmental habitats, much more diverse, in fact, than those which occur in Nebraska. It is highly probable, therefore, that the variation within the species of *Andropogon* is much greater than that which occurs within this state, particularly since none of the species is restricted to Nebraska. Thus far, the authors have not been able to delimit ecotypes within the material studied, and the significance of the genetic variability is currently being investigated.

However, the present study demonstrates the impossibility of determining the effect of the environment upon a plant species without controlling either the environment or the genetic variation between the individuals studied. With both variables uncontrolled, correct conclusions can be only fortuitous.

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A NEW BACOPA FROM CALIFORNIA

Herbert L. Mason

Bacopa Nobsiana sp. nov. *Bacopa* habitu *B. Eisenio* similis sed ab illa specie floribus parvioribus pedicellis quam folia suffulcientia brevioribus sepalis fructiferis patentibus capsulis ovoideis secundum septum valde canaliculatis discedit.

Floating, or prostrate and creeping herb, rooting at some of the nodes; stems and pedicels pilose to hirsute when young, becoming glabrate in age; leaves opposite, sessile, 1-2 or 3 cm. long, nearly as wide, orbicular-cuneate, clasping the stem, conspicuously palmately 5-7-nerved, glabrous, succulent; flowers 1-4 in each leaf axil; in anthesis pedicel and flower together, shorter than subtending leaf, sometimes elongating in fruit; calyx growing with fruit, the sepals 4 or 5, spreading in age; outer sepals 2, each 2 mm. long, almost orbicular, foliaceous, 5-7-nerved, one or sometimes both deeply cleft or parted; inner sepals oblong, 2 mm. long, 1 mm. wide, minutely ciliate-margined on lower half or sometimes glabrous, at first membranous, becoming firmer in age; corolla campanulate, white with yellow throat, lobes nearly equal, weakly disposed toward a grouping of two and three; stamens 4, inserted on throat, anthers versatile; ovary in anthesis asymmetrical; capsule broadly ovoid, 4 mm. long, conspicuously grooved up the sides and across the top along

Explanation of Figures 1-11.

Figs. 1-11. *Bacopa*. 1-9, *B. Nobsiana*: *1*, habit, × 0.8; *2*, opened corolla, × 4; *3*, *4*, two views depicting zygomorphic character of calyx, × 4; *5*, pistil, × 8; *6*, flower × 8; *7*, mature fruit showing spreading calyx lobes, × 6; *8*, cross section of ovary, × 6; *9*, seed, × 40. 10, 11, *B. Eisenii*: *10*, habit, × 0.8; *11*, mature fruit showing appressed calyx lobes, × 2. Figs. 1, 3-9 drawn from *Mason 12980*, and *Nobs & Smith 1097;* fig. 2 from *Carter 3064;* figs. 10, 11, from *Nobs & Smith 424*.